METHOD AND APPARATUS FOR IMPROVED FACIAL RECOGNITION

TECHNOLOGICAL FIELD

[0001] An example embodiment of the present invention relates generally to facial recognition, and more particularly, to a method, apparatus and computer program product improving the efficiency and accuracy of identifying facial characteristics and identifying a subject facial image as resembling a facial image in an enrolled group.

BACKGROUND

[0002] Facial recognition systems have proved useful in a variety of fields. Facial recognition has played a role in biometric security. For example, an automatic teller machine user's identification could be confirmed by capturing a real-time image of an individual as they withdraw cash from an account and comparing it to an image on record. Law enforcement has on occasion used facial recognition systems to identify wanted persons by capturing facial images in public crowds and comparing them against images in a database of wanted persons.

[0003] Although useful, current methods of facial recognition leave room for improvement. Variants across facial images, such as head tilt, illumination, and expression can negatively impact the precision of feature recognition, ultimately leading to failure in finding a match where the subject image is that of an individual that is indeed enrolled in a sample group or database.

[0004] Additionally, many methods aimed at improving facial identification success rates are implemented at the expense of efficiency. For example, precision could be improved immensely by analyzing every pixel of every image or applying complex normalizing algorithms to images. However, tasks such as these may be computationally expensive and slow the facial recognition process.

BRIEF SUMMARY

[0005] A method, apparatus, and computer program product are therefore provided for improving the efficiency and accuracy of facial recognition systems. Implementing facial recognition systems with improved efficiency leads to conservation of computation resources, which in turn can allow the systems to process a higher volume of images in a short amount of time. Systems that aim toward improving efficiency will better satisfy the demands of facial recognition systems implemented in public settings or those that require the processing of a high volume of images in a limited timeframe. Improving the accuracy of the system will lead to a greater number of successful identifications, and a lower error rate.

[0006] In one embodiment, a method is provided for identifying an enrolled image that resembles a subject facial image. A statistical property is identified by which to measure pixels in a block of the subject image. The measurements are converted into a feature vector, and utilized to identify facial characteristics, such as age, gender, or emotions. A feature vector may also be compared to enrolled feature vectors to identify a matching subject. Additionally, the method of one embodiment may compress the feature vectors of the subject and enrolled images by applying a dimension compression matrix. The method of some embodiments may determine the feature vectors by converting the measurements into histograms illustrating frequencies of unique property measurements, and, in some embodiments, may further convert a plurality of histograms in order to arrive at the feature vector for the image.

[0007] In another embodiment, a block division method is evaluated by first applying the block division method to a training group of images, comprising subsets of images of the same individuals. The images are then classified in accordance with this embodiment utilizing the feature vectors obtained with a common statistical measurement, and the results of the classification are used to determine a dimension compression matrix. The same block division method, statistical measurement, and compression matrix may be used to convert a group of evaluation images into feature vectors. The evaluation images may then be classified based on the vectors, and the success rate of the classification indicates the effectiveness of the block division method.

[0008] The method of some embodiments may employ a block division method in which blocks overlap one another. The method of other embodiments may employ techniques resulting in a division in which blocks are self-contained.

[0009] An additional embodiment provides a method for weighting the blocks and incorporating the weights into the feature vector in a way such that not every block has the same significance in the identification process. More specifically, another embodiment provides a method for determining the weight of a block through classification iterations of a training group, in which the iterations call for varying the weights of the blocks. Ideal weights may be identified by analyzing a block's impact on a classification error rate throughout the iterations.

[0010] Methods according to some embodiments include identifying a plurality of key points of the facial image, measuring distances from a pixel to a plurality of key points, and encompassing the pixel and a closest key point in a block. A method may also be provided to assign a weight to a facial feature point of the facial image and utilize the weight in normalizing the facial image prior to a vector conversion and identification process.

[0011] In another embodiment, an apparatus is provided that includes at least one processor and at least one memory including computer program code with the at least one memory and the computer program code configured to, with the processor, cause the apparatus to receive a subject facial image, determine statistical property measurements by pixel in a block of the image, convert the measurements into a vector, identify characteristics, and compare subject and sample vectors in order to classify the images. The at least one memory and computer program code may also be configured to, with the processor, cause the apparatus to compress the feature vectors, such as with a dimension compression matrix, or create histograms illustrating the frequency of statistical property measurements while converting an image to a feature vector. The at least one memory and computer program code may also be configured to, with the processor, cause the apparatus to utilize a training processes to evaluate various block division methods or block weights applied to a facial image.

[0012] Similarly, in a further embodiment, a computer program product is provided that includes at least one non-transitory computer-readable storage medium having computer-executable program code instructions to identify characteristics and facial images by utilizing feature vectors. Additional embodiments include a computer program prod-